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PATENT SPECIFICATION

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(19)

(54) PRESSURE REDUCER

(71) We, BRAUKMANN ARMATUREN AG, a Swiss Body Corporate, of 2, Bahnweg, Rothrist, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in by the following statement:—

The present invention relates to a pressure reducer for liquid vapours or gaseous media having a valve arranged to open in the direction of throughflow of medium and a movable member comprising a relief piston arranged on a spring-loaded valve spindle. The effective area of the movable member is made as a rule so large that it completely eliminates the inlet pressure force acting on the valve. Accordingly only the force of a spring, the stress of which is adjustable, acts upon the movable system.

Pressure reducers of this kind are pressure-balanced in the static condition. When flow takes place through the valve seat, a large part of the pressure energy is converted into kinetic energy in the region of the valve while the hydraulic or pneumatic pressure is fully maintained over the movable member. This inlet pressure which is constant over the movable member effects an over-relief and thus has a closing action upon the valve system. Thus the rate of through-flow is reduced in the case of greater pressure difference and thus a greater speed of flow results. In another pressure reducer an after-pressure over a diaphragm is influenced by means of a Venturi device in dependence upon the rate of throughflow. The after-pressure lowered by the Venturi device acts however not only in the opening direction upon the diaphragm, but at the same time also in the closing direction upon the movable member. A satisfactory improvement of the function of a Venturi device arranged on the after-pressure side of the diaphragm can therefore be expected only if the effective diaphragm area is large in relation to the diameter of the movable member. Thus unnecessarily large diaphragm areas, diaphragm superstructures and correspondingly strong ideal value springs are obtained. By reason of the large diaphragm area these pressure reducers are then mostly unsuitable against excessive inlet pressure and moreover are expensive in production.

There may be provided a pressure reducer of the initially stated kind which even in the case of a major pressure difference between input and output and thus high speed of throughflow, possesses a great rate of throughflow and nevertheless makes a relatively small diaphragm or the like and a normal ideal value spring suffice.

According to the present invention there is provided a pressure reducer for liquid, vaporous or gaseous media having a valve arranged to open in the direction of throughflow of the media and a relief piston arranged on a spring-loaded valve spindle of this valve and arranged to define with a cylinder in which it moves a relief chamber, the relief piston serving to compensate at least partly for a hydraulic compressive force arranged to act on a diaphragm connected to the spring loaded valve spindle; one surface of the relief piston within the relief chamber being loadable with inlet pressure and the other surface being loadable with outflow pressure, wherein flow of medium through the reducer is arranged to first pass a constriction and then the valve, the inlet of the relief cylinder chamber being in direct communication with the flow path between the constriction and the valve.

The constriction is defined between a wall or walls and a member defining the inlet to the relief chamber. The constriction effects a great rise of the speed of flow and thus a drop of the inlet pressure. Since the inlet or entrance of the relief chamber subjected to the inlet pressure is in direct communication with the flow path of medium between

the constriction and valve, the medium in which flow path is subject to a pressure reduction by reason of the constriction, the area of the relief piston is also relieved of pressure, which has an opening effect upon the valve. Thus with the aid of this development in accordance with the invention the rate of throughflow can be increased in the desired direction in the case of major pressure difference and thus higher speed of flow results.

The constriction is preferably formed as an annular gap. In a preferred embodiment of the invention the inlet of the relief chamber is defined by a tubular member which extends coaxially with the spindle and the all or walls defining the constriction comprise a tubular housing part having a valve seat at one end thereof, the constriction being formed between the member and housing part.

The annual gap extends over only that part of the length of the tubular housing part carrying the valve seat opposite to the tubular member.

The free end of the tubular member may be wider than the remainder thereof, to provide a smaller constriction. Since the valve and the relief piston are arranged coaxially on one and the same valve spindle and their effective surfaces possess the same diameter, the tubular housing part, in the region defining the valve seat, is so formed that when the valve engages the valve seat the diameter of the surface of the valve remaining exposed is the same as the diameter of the relief piston. The cross-section of the constriction decreases with increasing cross-section of the free end of the tubular member and only a narrow annular gap remains between the free end of the tubular member and the tubular housing part.

In another embodiment of the invention the tubular housing part defining the valve seat is wider in the region of the valve seat than the remainder thereof. Here especially it is provided that the constriction terminates at the beginning of this nozzle-type widening of the valve seat.

The valve spindle carrying the valve and the relief piston advantageously passes coaxially through the valve seat and the constriction.

In a further embodiment of the invention the outlet connector is hydraulically or pneumatically coupled with an after-pressure chamber through at least one connecting bore. Another development of the invention provides that the after pressure chamber is partially defined by a diaphragm on the outer surface of which a loading spring bears and which is connected for movement with the valve spindle.

Various embodiments of the present invention will now be described by way of example, with reference to the accompany drawing, wherein:—

Figure 1 shows a vertical longitudinal section through a pressure reducer in accordance with the invention;

Figure 2 shows a detail of a longitudinal section through a variant of embodiment of the pressure reducer; and

Figure 3 shows the same detail as Figure 2, but of a further form of embodiment.

Referring now more particularly to Figure 1, there is shown a pressure reducer in accordance with the invention, which possesses a housing 1 having an inlet connection 2, an outlet connection 3 and a cover 4 made in hood form. The latter consists of synthetic plastics material. Between a housing shoulder 5 and a terminal lower or inner end face 6 of the cover 4 there is clamped a reinforced edge of a diaphragm 7. The diaphragm carries on its underside a reinforcing plate 8 and on its upper or outer side a disc 9 of pot form which likewise serves to stiffen the middle part of the diaphragm and to support the lower end 10 of a loading spring 11. The latter is stressed with the aid of a pressure member 12 which possesses an annular groove 13 for the guidance of upper spring end 14 and a central female thread for a screw 15 which is rotatable from the exterior of the pressure reducer but axially non-displaceable relative to the cover 4. A removable operating element can be applied to the square head 16 of the screw 15 so as to effect rotary movement of the screw. In order to prevent rotation of the pressure member 12, it is provided with a vertical longitudinal groove 17 on its outer edge, in which a rib 18 on the inner peripheral surface of the cover 4 engages.

Passing through and fixed to the diapragm 7 is a valve spindle 19. Although not shown appropriate sealing is provided at this point. A spindle head 20 serves for the extraction of the spindle 19. The latter carries a relief piston 21 and at its lower end a valve 22. The latter is removable in a manner not illustrated, and for this purpose the bottom 23 of the housing 1 is made detachable in a manner likewise not illustrated. The valve 22 rests on a valve seat formed by one end of a wall or walls, preferably a tubular housing 24. The free end of this tubular housing is formed as a nozzle 25.

In the case of incomplete pressure equilibrium within the pressure reducer and with the spring 11 stressed, the valve 22 is disengaged from the valve seat and permits the passage of a medium, the pressure of which is to be reduced. The medium flows in through the connector 2 in the direction

of arrow 26 and departs from the pressure reducer in the same direction by way of the outlet connector 3.

The piston 21 together with its gasket 27 is displaceable upwards and downwards in a cylinder 29 in the direction of double arrow 28. This cylinder is made in one piece with an insert 30 consisting of synthetic plastics material. This insert is secured in the housing 1 and sealed off against the housing by means of the O-ring 31. The cylinder 29 is adjoined by a tubular extension 32, the upper end of which has a conical formation for adaptation to the different tube diameters, so that as a whole a funnel-shaped formation is produced. The free or lower end of the tubular extension 32 extends into the housing part 24 defining the valve seat. Therefore over about half the length of the part defining the valve seat, an annular gap 33 is produced. A second annular gap 34 is formed between the inner wall of the tubular extension 32 and the valve spindle 19 which passes centrally through not only the part 24 defining the valve seat but also the tubular extension 32, the cylinder 29 and also the diaphragm 7. The lower free end of the valve 22 is located by a stop 35 fast with the housing.

An outflow chamber 36, that is the chamber through which the medium flows after the valve seat, is connected with an after-pressure chamber 37 through a constriction bore 38. The latter passes through a housing wall 39 and through a tubular part 40 of the insert piece 30, which securely abuts the edge of the diaphragm.

In order to describe the operation of the pressure reducer it is assumed that the string 11 is tensioned by means of the pressure member 12 and screw 15. The force applied by the spring 11 is then such as to bias the valve 22, via spindle 19, substantially into its fully open condition without pressure medium within the reducer. With pressure medium stationary within the reducer, due to some form of blockage on the outlet side thereof, the pressure of the medium is constant throughout the reducer and the valve 22 is biased towards its closed position.

When the medium flows through the housing 1 of the pressure reducer according to the invention, with the valve 22 open the medium firstly passes through the constriction 33. This results in an increase of the speed of flow and a reduction directly connected therewith in the static pressure in a chamber 41. Since this chamber 41 located upstream of the valve 22 is in communication with the constriction through the tubular extension 32 of the cylinder 29, the pressure in the chamber 42 and thus the pressure force acting upon the underside of the piston 21 are thereby also reduced. This leads to a movement of the spindle in the opening direction of the valve 22, due to the effect of the spring 11 and the higher pressure acting on the upper side of the piston 21. The pressure drop at the constriction 33 is the greater, the higher is the speed of flow at this point. The speed of flow again is a consequence of the pressure difference between inflow and outflow pressures.

A pressure prevailing in the outflow chamber 36 establishes itself in the after-pressure chamber 37 after a delay depending upon the diameter or crossection of the bore 38. So that sudden pressure fluctuations of the outflow chamber 36 are buffered from the after-pressure chamber 37 and thus finally from the upper side 43 of the piston 21, the cross-section of the bore 38 is made small relative to the crossection of the outlet connection 3.

Since the bore 38 serves to buffer the pressure fluctuations, clearly the change in pressure within the chamber 37 is not as fast as that in chamber 36. Consequently, the force applied by the pressure medium acting on the diaphragm 7 does not alter quickly and the downward movement of the piston 21 and spindle 19 takes place gradually in accordance with the reduction in pressure on the diaphragm, which opposes the downward force imposed by the spring 11 and the pressure medium downward force acting on the piston 21.

In the exemplary embodiment of Figure 2 the free end of the tubular extension 32 of the cylinder 29 is formed in the manner of a nozzle 44. Otherwise this form of embodiment does not differ from that of Figure 1. The same also applies to the design according to Figure 3 which differs from the example of embodiment according to Figure 1 only in the nozzle-shaped formation of the housing part 24 defining the valve seat, the beginning of the nozzle coinciding approximately with the end 46 of the annular constriction 33. The embodiments of Figure 2 and 3 provide a more distinct nozzle than that of Figure 1 which illustrates a rather rounded-off outflow end.

WHAT WE CLAIM IS:—

1. A pressure reducer for liquid, vaporous or gaseous media having a valve arranged to open in the direction of throughflow of the media and a relief piston arranged on a spring-loaded valve spindle of this valve and arranged to define with a cylinder in which it moves a relief chamber, the relief piston serving to compensate at least partly for a hydraulic compressive force arranged to act on a diaphragm connected to the spring-loaded valve spindle; one surface of the relief piston within the relief chamber being loadable with inlet pressure and the

other surface being loadable with outflow pressure, wherein flow of medium through the reducer is arranged to first pass a constriction and then the valve, the inlet of the relief cylinder chamber being in direct communication with the flow path between the constriction and the valve.

2. A pressure reducer as claimed in claim 1, wherein the constriction is defined between a wall or walls and a member defining the inlet to the relief chamber.

3. A pressure reducer as claimed in claim 2, wherein the inlet of the relief chamber is defined by a tubular member of smaller cross-section than the cylinder, which tubular member extends concentrically of the spindle, and wherein the wall or walls defining the constriction comprise a tubular housing part, one end of which defines a valve seat.

4. A pressure reducer as claimed in claim 3, wherein the constriction is formed as an annular gap.

5. A pressure reducer as claimed in claim 3 or 4, wherein the free end of the tubular member is wider than the remainder thereof.

6. A pressure reducer as claimed in claim 4 or 5, wherein the valve seat of the tubular housing part is wider than the remainder thereof.

7. A pressure reducer as claimed in claim 4, 5 or 6, wherein the spindle passes through and is coaxial with the valve seat and the constriction.

8. A pressure reducer as claimed in any of the preceding claims, further comprising an after pressure chamber, a bore connecting the outlet connector with the after pressure chamber.

9. A pressure reducer as claimed in claim 8, wherein the after pressure chamber is at least partly defined by a diaphragm and the other surface of the relief piston.

10. A pressure reducer as claimed in claim 9, further comprising a loading spring in engagement with the side of the diaphragm opposite to that defining part of the after pressure chamber, the diaphragm being connected to the valve spindle for movement therewith.

11. A pressure reducer substantially as hereinbefore described with reference to Figure 1 or Figure 1 as modified by Figure 2 or Figure 3 of the accompanying drawing.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig. 1

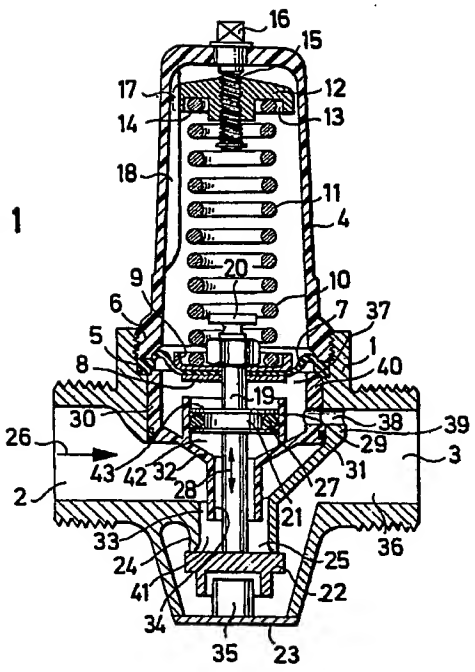

Fig. 2

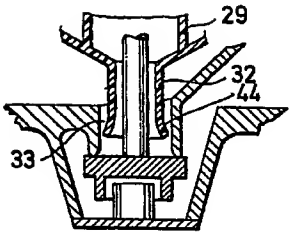

Fig. 3